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Military Sealift Command tanker market forces and cost factors

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MILITARY SEALIFT COMMAND TANKER
MARKET FORCES AND COST FACTORS

by

David P. Burnette

December 1984

Thesis Advisor: D. C. Boger

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Military Sealift Command Tanker Market Forces and Cost Factors

by

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Submitted in partial fulfillment of the requirements for the degree of

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December 1984

ABSTRACT

As the United States Navy operating agency for ocean transportation, the Military Sealift Command (MSC) operates a fleet of tankers to supply the military petroleum needs of Defense Department units around the world. To fulfill Defense requirements, MSC maintains a controlled fleet of approximately thirty tankers that are either owned by the government or are chartered on a long term basis from commercial shipping companies. This thesis attempts to analyze those market forces and cost factors that contribute to the charter rate structure that has such a significant impact on MSC operating costs. The market forces analyzed are the worldwide demand for oil, the location of refineries, advancing technology, and legislation. The tanker cost factors discussed are operating, voyage, and capital costs.

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I. INTRODUCTION

The Military Sealift Command currently operates a fleet of clean product tanker vessels in support of Department of Defense and Department of Energy requirements throughout the world. This study concerns itself with the clean product tanker operations carried out by MSC chartered and contracted ships in support of requirements as determined by the Defense Fuel Supply Center (DFSC) in Alexandria, Virginia. DFSC, as the Department of Defense (DOD) agency responsible for fuel allocation, draws up annual predictions for the quantity of petroleum it expects to be transported. Using this estimate MSC configures its "controlled" tanker fleet of Navy owned and long-term chartered vessels so that it can handle about eighty-five per cent of anticipated annual requirements. It then charters commercial tankers when necessary to carry that petroleum which is beyond the capacity of the controlled fleet. If requirements are less than expected, MSC controlled fleet assets are put into a ready reserve status for a period of time.

It is this mix of Navy contracted, long-term charter and short-term or "spot" charter tankers that is fundamental to this study. "The entire Defense petroleum distribution network, including tankers, is designed and aimed at delivering the product at the cheapest cost to the customer, which makes it similar to the commercial market within which it exists" [Ref. 1].

As the operational and financial manager of these tanker assets, MSC has a tremendous concern for the costs incurred in transporting Defense fuel. Ideally, this fuel would be shipped by the most cost effective means at all times, but because of the sporadic nature of the tanker market, "the

most cost effective means" could change on an almost daily basis.

This thesis will review the basic organization of the Tanker Division of the Military Sealift Command and the way it does business. The study will culminate with a detailed look at the market forces at work in the petroleum tanker industry, and, in particular, how those forces affect the Military Sealift Command and the configuration of its tanker fleet.

It must be understood that this study is not concerned with the Fleet Support, civil-service-manned T-AOs. These vessels do not operate under the auspices of the Tanker Division; they are, instead, controlled by the area commands and operate under entirely different circumstances.

II. TANKER OPERATIONS OVERVIEW

An understanding of the cost factors affecting MSC tanker operations would not be complete without a basic awareness of the mission and organization of the MSC tanker fleet.

A. MILITARY SEALIFT COMMAND TANKER OPERATIONS MISSION

As an element of the Operations Office within MSC, the Tanker Division acts as the Navy's sole representative in the Defense petroleum distribution network and elaborates on its mission as set forth in Figure 2.1 as follows:

> Our nucleus fleet is employed in serving the overseas lift requirement of the Department of Defense. It is specifically sized to meet the lift requirements generated by the Defense Fuel Supply Center. The entire Defense petroleum distribution network, including the tankers, is designed and aimed at delivering the product at the cheapest cost to the customer, which makes it similar to the commercial market within which it exists. [Ref. 2]

There are three basic activities in which the Tanker Division fleet is involved.

1. The delivery of refined petroleum products to military installations throughout the world.
2. Deliveries of petroleum to ships at sea.
3. The delivery of crude oil in support of the Strategic Petroleum Reserve (SPR) as directed by the Department of Energy (DOE).

The first activity listed is considered to be the most critical function undertaken by the Tanker Division. Most of the effort expended by the personnel and the majority of the costs incurred by the Division involve this first function. The manner in which it is carried out is simple but effective.

MISSION OF THE TANKER DIVISION

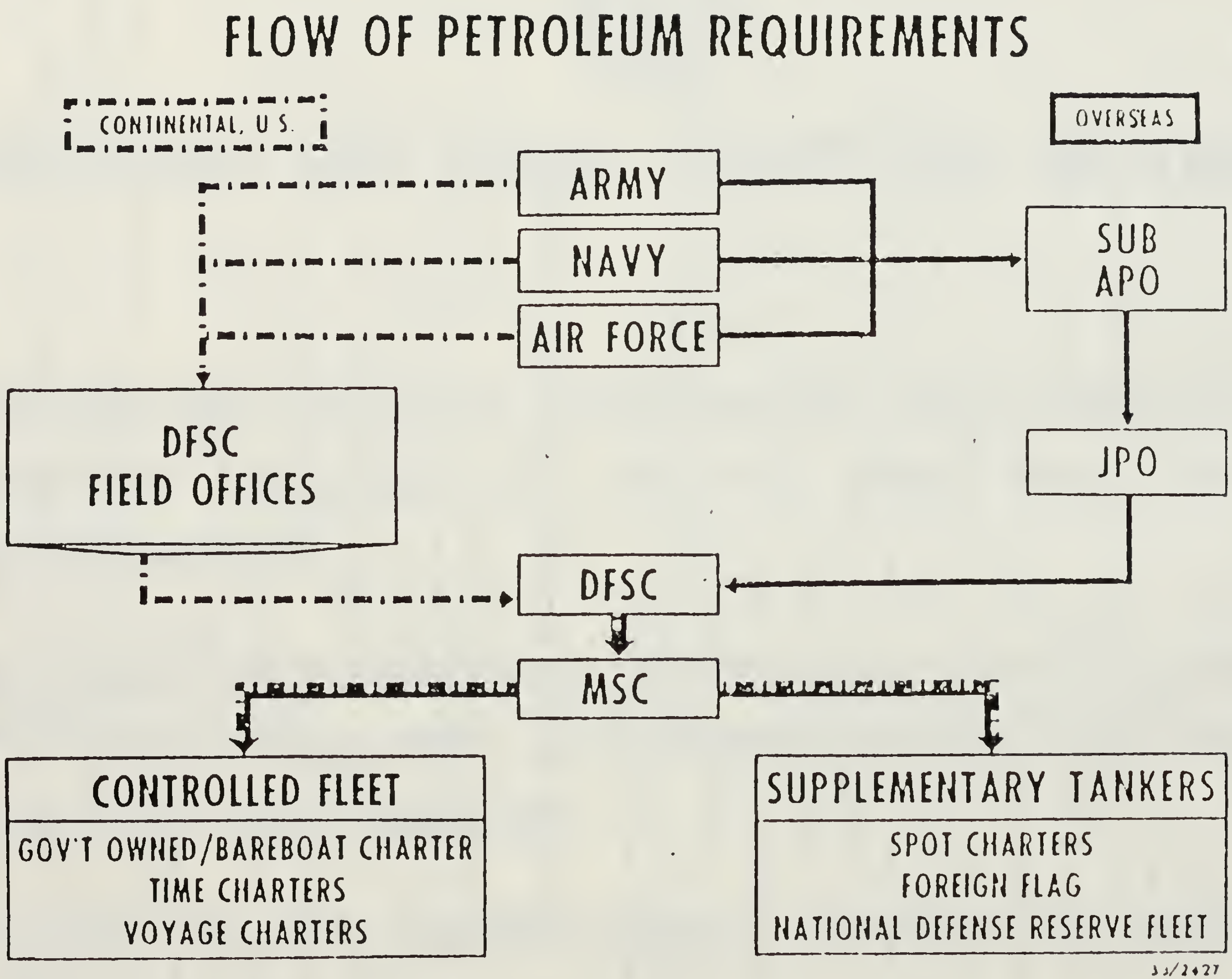
- OPERATE MSC NUCLEUS TANKER FLEET AND OTHER BULK POL CARRIERS ACQUIRED BY MSC TO MEET BULK POL LIFT REQUIREMENTS
- ARRANGE FOR COMMERCIAL SHIPPING TO MEET DOD AND DOD SPONSORED BULK POL LIFT REQUIREMENTS WITH MAXIMUM EFFICIENCY AND ECONOMY
- PROVIDE TANKER UNREP/CONSUL SUPPORT TO OPERATING NAVAL FORCES

Figure 2.1 MISSION OF THE TANKER DIVISION

Dry cargo charter activities within MSC have always been a managerial function of the individual area commands. Each of these commands has its own personnel authorized to handle contracting and chartering duties. Vessels are chartered on a daily basis independent of headquarters command in Washington. The reasons for centralized control of tanker shipping are twofold. As discussed previously, the close physical proximity of DFSC and MSC headquarters is a factor, but even more important is the historical effect of the oil embargoes that have taken place in the past and the resultant criticality of fuel logistics in order to ensure Defense readiness. Dry cargo operations are normally much less "time critical" from MSC's point of view. The Military Airlift Command (MAC) provides the military a rapid alternative to ocean transportation. There is no such reasonable alternative when it comes to petroleum transportation, so it is critical that control of petroleum shipments be responsive. This is partially accomplished by centralizing control at headquarters.

B. THE ROLE OF THE DEFENSE FUEL SUPPLY CENTER

As previously mentioned, MSC transports petroleum as directed by DFSC. DFSC was given this charter in 1973 and placed under the direction of the Defense Logistics Agency, which, in turn, is under the direction of the Office of the Secretary of Defense. DFSC continually collects fuel usage data through its field offices throughout the world (See Figure 2.2) and uses the data to compile the Inventory Management Plan (IMP).
The IMP is a forecast of the types of fuel that will be used and the areas in which it will be used in the upcoming fiscal year. It is published annually with regular quarterly changes and is also updated on a daily basis. Much of



Source: Military Sealift Command, Washington, D. C.

Figure 2.2 Flow of Petroleum Products

the information collected is reflected in the Defense Guidance that is used to help formulate the budget proposal presented by the President to Congress.

Both DFSC and MSC operate under financial conditions similar to their commercial counterparts. In MSC's case, financing is through the Navy Industrial Fund (NIF) [1] while DFSC is financed through the Defense Fuel Stock Fund. Both systems are similar and provide the primary constraint that a financial breakeven point is to be the goal. This is achieved through the use of a rate system whereby customers are charged for the services rendered and expenses are debited from the balance.

These financial systems provide a cost reduction initiative and, in addition, simplify activity accountability. Since a large portion of the costs incurred by DFSC are fees paid to MSC for transportation of the petroleum products, the Command is constantly seeking less costly modes for fuel transportation. Pipelines and barges have been much more extensively utilized during recent years, but have yet to dramatically affect the overall scope of operations.

C. ORGANIZATION OF MILITARY SEALIFT COMMAND TANKER DIVISION

As the sole agent of the Navy for transportation of petroleum, oil and lubricants (POL), Tanker Division consists of two branches that perform the required functions.

The Tanker Management Support Branch has several responsibilities:

1. Develops operational plans, both short-range and long-range.

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[1] The Navy Industrial Fund will be explained in more detail in Chapter 3, Section A.

2. Develops policies and procedures for the world-wide movement of POL.
3. Monitors and ensures accurate preparation of reports upon which POL billings are based.
4. Prepares the Tanker Division overhead budget. [Ref. 3]

The Tanker Operations branch exercises direct operational control over vessels chartered and contracted by MSC. In addition, the branch keeps shipowners informed of the movements of their ships and provides them with any information deemed appropriate. As discussed previously, the branch acts as the primary contact with DFSC. It also prepares monthly estimates of tanker fleet capability and accordingly initiates requests for additional charters or release actions to reduce capability when required. [Ref. 4]

Within the headquarters organization in Washington, the Tanker Division works very closely with the Chartering Branch of the Contracting Office. For simplification purposes, the pertinent portions of the MSC command structure are illustrated in Figure 2.3.

As depicted in Figure 2.3, the Contracting Office has separate branches under the Chartering Division for dry cargo and tanker operations. The Tanker Branch is constantly involved in negotiations with shipping companies and brokers. Its primary function is to arrange for transportation of POL as economically as possible while, at the same time, meeting the operational requirements of the move as delineated by the Tanker Operations Branch of the Tanker Division. If, in the opinion of the Charterting Division of the Contracting Office, the only mode of transportation available, within the constraints of the designated operational requirements, would incur unrealistic costs, then consultation takes place between the Contracting Office and the Tanker Division to arrive at a more cost efficient mode.

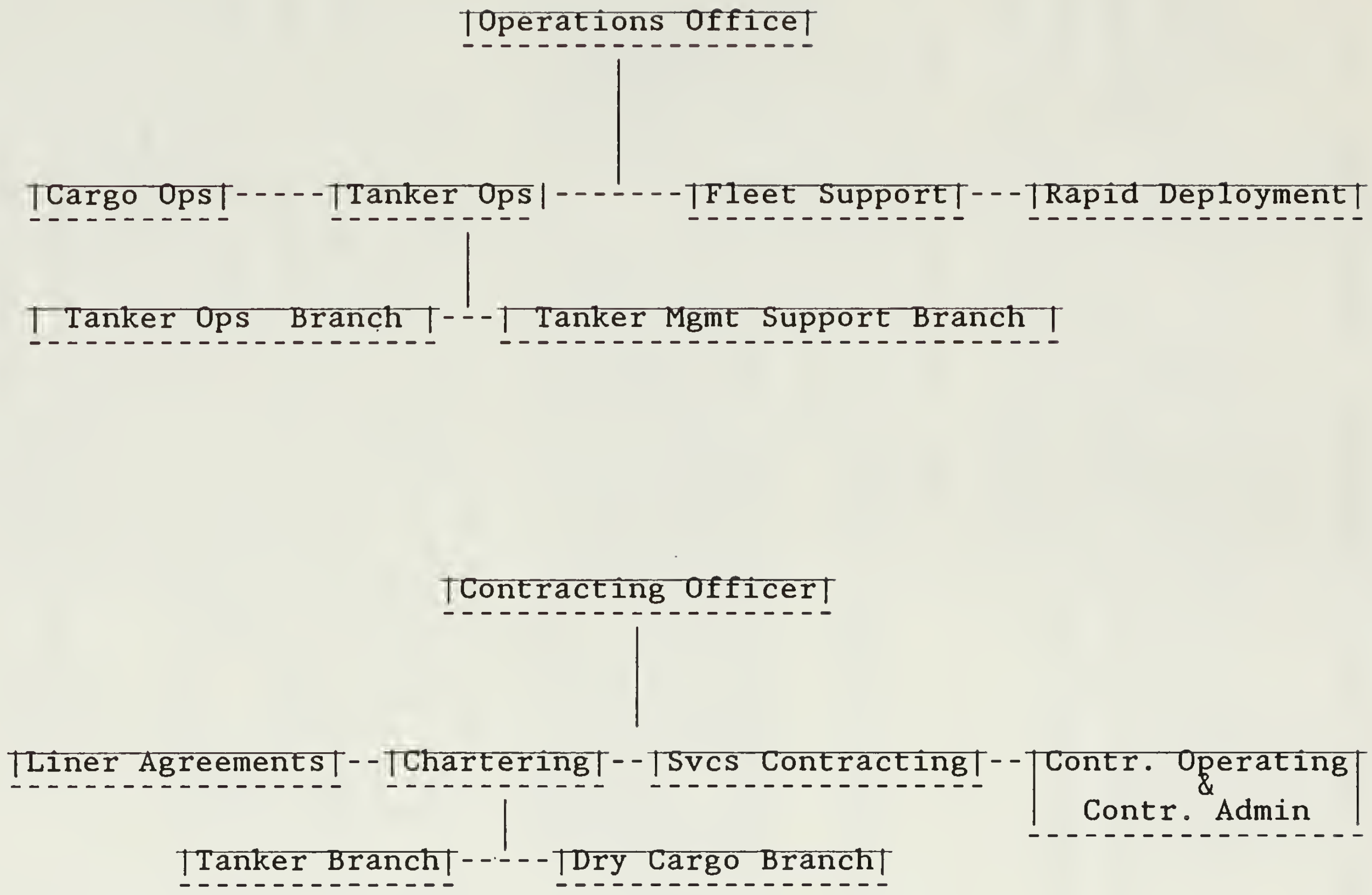

Figure 2.3 Organization of the Operations and Contracting Offices.

DFSC is notified if it is felt that an alternative to the move, as directed by them, should be pursued.

III. THE FINANCIAL STRUCTURE OF MSC TANKER OPERATIONS

As a prelude to an analysis of the market forces that affect costs incurred as a result of MSC tanker operations, an explanation of some of the more important concepts is paramount. In this chapter, the Navy Industrial Fund (NIF), charter classifications, and cost-affecting innovations in the industry will be addressed.

A. THE NAVY INDUSTRIAL FUND

As has already been stated, MSC worldwide operations are financed through the NIF.

> The NIF is a revolving fund established to provide working capital for industrial or commercial type activities of the Navy which provide goods or services to agencies of the Department of Defense. The NIF is not dependent upon Congressional appropriations since MSC charges its customers for services provided in a manner comparable to private business. The primary difference between a government industrial fund and a commercial business is that the objective of the government fund is to break even rather than to return a profit. [Ref. 5]

Utilizing projected requirements data provided by the Army, Navy, Marine Corps and Air Force, the MSC comptroller prepares the annual budget for submission to the Defense Department comptroller via the Navy comptroller. An initial outlay of inventories and cash is made to an activity to serve as the capital for operations. Items financed by MSC from revenues received for transportation services provided by the command include:

1. ship charter costs
2. provisions, supplies and materials
3. civilian payroll costs
4. travel expenses
5. spare parts for ships

6. maintenance,repair and alteration of ships
7. some damage claims
8. other normal expenses

Pay for military personnel is funded from Navy appropriated funds. Billing rates are then established to recover command expenses. The MSC comptroller is also responsible for billing for services rendered, maintenance of command financial records, and payment of command obligations for goods and services received.

If a profit is made in any fiscal year, or a loss is incurred, the billing rates are adjusted in subsequent years to recover losses incurred or to return profit to the sponsors. The command can obtain additional funds from the NIF in the event a drastic and unexpected deviation from the budget takes place, such as has occurred during past oil embargoes. The financial cycle of the NIF, as it applies to MSC, is illustrated in Figure 3.1.

The billing rates utilized by MSC are designed to apply uniformly to all shippers. While dry cargo rates are based on the going commercial rates for various commodities moving on breakbulk and container ships, POL rates are based on the size of MSC controlled tankers and the number of discharge and loading stops on one voyage.

MSC constructs a tariff based upon its projected costs for carriage of a long ton-mile of POL products. As the services are rendered, MSC bills DFSC for the cost of transportation services. DFSC, in turn, adds the transportation costs to the cost of the POL products and is reimbursed by the armed services using the products. The armed services are responsible for including in their appropriation requests to Congress amounts adequate to cover the purchase and transportation of POL products. Therefore, the dollar costs of the operation of the tanker fleet are passed on through the Navy Industrial Fund to the Operations and

```
------>|---------------CUSTOMERS---------------|------
|      ---------------------------------------       |
|      |Army | Navy/Marine Corps | Air Force | Other|  |
|      ---------------------------------------       |
|         |           |                |        |     |
|         V           V                V        V     |
|   |-----------CUSTOMER REQUIREMENTS-------------|  |
|   -----------------------------------------------  |
|   | Dry Cargo | Petroleum | Project | Fleet Support | |
|   -----------------------------------------------  |
|         |          |          |           |        |
|         V          V          V           V        |
|       -----------------------------------------    |
|       |     MSC PERFORMANCE OF SERVICES       |    |
|       -----------------------------------------    |
|                         |                          |
|                         V                          |
|               |-MSC INDUSTRIAL FUND-|              |
|               -----------------------              |
------------------| Billings | Receipts |<-------------
               -----------------------
```

Source: Military Sealift Command, Washington, D. C.

Figure 3.1 Industrial Fund Financial Cycle.

Maintenance accounts of the armed services receiving the products. [Ref. 6]

B. THE CLEAN PRODUCT TANKER

While the size of the world's tanker fleet has been diminishing for several years, the forecast of the smaller supply of vessels on which to transport POL is complicated from MSC's perspective. With the exception of the crude that is carried by MSC chartered vessels for DOE in support of the SPR, most of the shipments of petroleum coordinated by the Tanker Division are for shipments of refined fuels in quantities too small to be economically transported in large tankers. In fact, almost sixty per cent [Ref. 7] of the fuel carried aboard Navy contracted or chartered vessels is jet fuel, with the inherently stringent purification

requirements necessary for subsequently safe operational utilization. (See Figure 3.2)

Another factor limiting the supply of tanker resources available to MSC for POL transportation is MSC's desire that the vessels be multi-product capable. To conform to this constraint requires that a relatively expensive coating be applied to the tanks to be used. Specifically, MSC defines a clean product tanker useful for its purposes as "a vessel that is appropriately coiled, coated and compartmentalized to enable it to carry several grades of petroleum products without contaminating or mixing with other cargoes" [Ref. 8]. Another important factor taken into consideration in determining the type of vessels best suited for MSC POL transportation purposes is the ship's size. DOD shipment sizes rarely justify the use of a tanker with more than a 50,000 Deadweight Ton (DWT) [2] capacity, and many of the ports in which MSC ships operate have water depths too shallow for a vessel of larger than a 50,000 DWT capacity to enter while loaded.

It can be seen in Figure 3.3 that, while the overall number of tankers in the U.S. flag fleet is not significantly less than it was ten years ago, the number of tankers involved in the clean product trade has diminished at a rapid rate. Figure 3.5 and figure 3.4 provide additional statistics concerning product tanker availability.

C. CHARTER TYPES

An understanding of the different classifications of vessel charters is essential in order to fully comprehend the nature of the problem at hand.

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[2] Sometimes termed deadweight carrying capacity, is the difference between the light and loaded displacements of a ship. The deadweight (dwt) comprises the ballast, fresh water, fuel oil, passengers, crew and their effects. [Ref. 9]

USEFUL CLEAN PRODUCT TANKER

- 10,000 - 50,000 DWT
  - — Can load/discharge at most clean product terminals worldwide

- Multi-Product Capable
  - — Characteristic of small clean product tanker, i.e., more cargo compartments, more complex piping and specially coated tanks

Source: Military Sealift Command, Washington, D. C.

OC 3768 280283/021

Figure 3.2 Useful Clean Product Tanker

U.S. FLAG TANKER FLEET SERVICE*

YEAR	# IN CLEAN TRADE	# IN DIRTY TRADE	# IN COMBINED TRADE	TOTAL
1983	60	130	11	201
1982	72	138	16	226
1981	71	142	9	222
1980	87	136	—	223
1979	99	125	—	224
1978	132	91	—	223
1977	143	71	—	214
1976	145	62	—	207
1975	137	73	—	210

*As of May or June of each year

Source: Military Sealift Command, Washington, D. C.

Figure 3.3 U.S. Flag Tanker Fleet Service

INVENTORY OF PRIVATELY OWNED TANKER FLEET (DWT)*

5,000 DWT & OVER

3 JUNE 1982

5,000 to 29,999		30,000 to 49,999		50,000 & OVER		TOTAL		GRAND TOTAL
clean	dirty	clean	dirty	clean	dirty	clean	dirty	
30	24	36	53	1	76	67	153	220

* EXCLUDES SPECIAL CHEMICAL TANKERS AND USNS TANKERS UNDER BAREBOAT CHARTER

Source: Military Sealift Command

Figure 3.4 Inventory of Privately Owned Tanker Fleet

1986 PRODUCT TANKER FLEET EMPLOYMENT

MARKET FORCES

Source: Military Sealift Command, Washington, D. C. 3T2x/2174/100583-01

Figure 3.5 1986 Product Tanker Employment

Time Charter. This type of charter can be an arrangement that lasts for only a few weeks or for years. MSC time charters vary from four months to twenty years in length. In this arrangement, the shipowner is responsible for providing the crew, managing the ship, and paying all operating costs except port charges, canal tolls and fuel. The charterer has the right to use the ship in any location and for any cargo that he chooses, except as prohibited by the terms of the contract. The owner agrees to meet charter provisions on speed and fuel consumption and to maintain the ship in accordance with the standards of her class. The charter rate is normally based on dollars per deadweight ton per month or dollars per day. The contract usually provides a provision for payment of increases of crew wages, stores and subsistence if the charter period is more than one year. [Ref. 10]

Bareboat Charter. In this type of charter arrangement, the owner relinquishes management and control of his ship to the chartering agency for several years, and sometimes for the life of the ship. The charterer mans and operates the ship, and is responsible for all costs of operation, including port charges, fuel costs and canal tolls. He is expected to return the ship to its owner, when the contract expires, in good condition, subject to normal wear and tear.

The chartering agency pays at a rate expressed in terms of a certain amount of deadweight tons per month or dollars per day. For the owner of of the ship, such an arrangement can be an investment opportunity, so the rate he negotiates should cover depreciation and his profit. The charterer, on the other hand, is able to pay for the ship as he uses it instead of having to pay the entire cost in advance. MSC operates under a number of bareboat charters, including nine

new tankers that were procured under "build and charter programs". [Ref. 11] [3]

Consecutive Voyage Charter (CVC). The owner remains completely responsible for the operation and cost of the ship, including port and fuel charges. The charter provides for the ship to make as many consecutive voyages as it can in a specified period of time. Payment is expressed in terms of the amount per ton of cargo carried and is normally payable only upon the successful discharge of the cargo at the end of the voyage. If the charterer does not supply a full cargo, the charterer must pay for the unused space. Again, there is usually a provision for payment of the escalation of crew wages, bunkers, stores and subsistence. [Ref. 12]

Single Voyage Charter. This is an arrangement similar to the CVC except that it involves only one shipment instead of several. This type of charter is normally referred to as a "spot charter" and is a critical aspect of this study. [Ref. 13]

Contract of Affreightment. This type of agreement calls for the transportation of a specific amount of cargo in an agreed upon trade and time period. The major difference is that the owner does not commit specific ships. He has the ability to provide any ships that meet the requirements and fall within the size range as specified in the agreement. The contract designates the approximate volume of cargo, the description of the cargo and the voyages, and the time period during which all the cargo must be moved.

This arrangement is attractive to a charterer since it gives him more flexibility than most arrangements. It is often a cheaper method of securing transportation because it frequently allows a charterer to avoid paying for the ship's

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[3] Build and charter programs will be discussed in more detail in Chapter III, Section D.

ballast portion of a round-trip voyage. The rate is based on the cargo tons loaded, expressed by a rate per ton of cargo, and the cost of service is usually payable upon completion of successful loading. [Ref. 14]

The rate structure of the various forms of charter arrangements is somewhat complicated. Specific rates fluctuate dramatically on a day-to-day basis, making it very difficult to consistently choose charter types that will continue to be the most cost effective arrangement available throughout the life of the charter. Because of this fact, it is critical that personnel involved in charter selection and contract negotiations be aware of the market forces that influence charter rates. An ability to forecast future market conditions is absolutely essential in order to minimize life cycle costs incurred. It is this constant attempt to achieve a least cost solution to a charter arrangement, within the operational constraints [4] specified that produces the variety of charter types existing under MSC cognizance at any given time.

D. CHARTERING PROCEDURES

After analysis of POL shipment directives from DFSC, Tanker Division submits a requirement to the Contracting Office. Upon receipt of these requirements, a Request for Proposals is released to the maritime industry. The Bidders Mailing List for tanker proposals totals over two hundred firms. [Ref. 15]

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[4] Although not discussed previously, these "operational constraints" also include the necessity for a "surge" capability in the event of any contingency event that would require rapid, frequent and, possibly, large volume moves of POL around the world. The desired magnitude of this surge capacity has been a matter of debate for many years and is beyond the scope of this study.

The evaluation of offers received in response to Requests for Proposals includes consideration of:

1. vessel availability
2. positioning
3. suitability
4. size
5. speed
6. fuel consumption
7. tank capacity
8. tank coating condition (although a certification inspection will still be conducted by a MSC engineer prior to onload)
9. cargo previously carried
10. number of cargo tank systems
11. capacity of the cargo tank systems.

An analysis of the charter market is an ongoing activity in the Contracting Office. An awareness of the prices being paid on the commercial market for the tonnages in question, as well as the availability of shipping, forms the basis from which the negotiations are conducted with offerors who were responsive to the Request for Proposals. Negotiations for charter hire normally cover the following areas:

1. the period of the charter
2. the charter rate
3. the terms and conditions required by the Government
4. where the Government would take delivery of the ship
5. at what port the ship would be delivered to the shipowner upon completion of the charter
6. escalation payments
7. when escalation payments would become effective.

[Ref. 16]

Negotiations for long-term time charters or build-and-charter programs involve all facets of cost and operational factors. All of the resources within MSC are utilized to

improve the Government's negotiating position. The expertise available includes operations, counsel, comptroller, engineering, and can even include the U. S. Coast Guard, the Maritime Administration, or shipping organizations.

Some charter agreements contain options for the extension of all time lost due to a vessel's inability to perform. The decision as to whether to exercise one of these options requires the same thoughtful analysis as that utilized in determining the original contract.

E. BUILD AND CHARTER PROGRAMS

The principle upon which the Build-and-Charter program is based is a simple one. The Government enters into an agreement with a commercial firm which specifies that if the firm constructs a designated number of tankers in accordance with Government specifications, the Government will charter the vessels at an agreed upon rate and, normally, in a manner that will protect the investment in the long run. The advantage of this program to MSC is obvious. It enables the Navy to increase its tanker assets on a long-term basis without being required to seek Congressional authorization to do so. Payment for the charters is funded through the Operations and Maintenance, Navy (OM,N) fund, although close Congressional scrutiny certainly takes place. Since the Build and Charter program is generally considered a success from both the Navy and maritime industry perspectives, it is worthwhile to review the program in a little more detail.

In August 1974, the first of nine 25,000 DWT Sealift class product tankers was delivered to MSC. It was not the first time that a build and charter technique had been used by the Navy to acquire new assets [5] but it was, by far, the

[5] As a matter of fact, nineteen previous build and charter arrangements had been entered into since 1952. [Ref. 17]

most ambitious of the projects.

The first attempt to acquire tankers through the program came in 1968. Requests for Proposals (RFPs) were issued for a long-term CVC of nine newly constructed tankers. Because of the rising interest rates in that year, the prospective owner of the ships was unable to secure the necessary financing. The program was subsequently stopped.

In 1970 a review determined that the build and charter method could be successful only if the Government assumed the risk of fluctuations in the interest rates for the financing of the vessels.

In February 1971, a new RFP was issued, and fourteen offers were received. These offers were analyzed on the basis of discounting the respective charter payments over twenty years. The offers were then compared on a least-cost basis and on the ability to satisfactorily achieve the specifications and requirements established for the nine tankers. [Ref. 18]

In August, 1971, MSC accepted a bid from a consortium consisting of Marine Transport Lines, Inc., Salomon Brothers, and First National City Bank of New York. This consortium, acting through Marine Transport Lines (MTL), awarded contracts at the end of that year to Todd Shipyards Corporation and Bath Iron Works for the construction of a total of nine tankers. Table I shows the fixed-price contract costs.

MSC took an active role, during the formulation of the agreement, in the financial structuring of the consortium's investment to help ensure the greatest return on their investment. MSC sought advice from the Internal Revenue Service concerning depreciation schedules and allowable tax deferrals. The IRS ruled, in mid-1972, that the consortium could be treated as a partnership and that ninety-five per cent of the cost of the tankers could be depreciated in

TABLE I

Contract Prices for the Sealift Tankers

Contractor	Unit Price	Units	Total Price
Bath	$16,031,000	5	$80,155,000
Todd	$16,595,000	4	$86,380,000
			Total: $146,535,000

Source: General Accounting Office

about fourteen years. The charter hire rates were based upon a target rate of return desired on the equity investment and resulted in a net effective interest rate slightly lower than the prevailing interest rates on direct U. S. Treasury obligations. [Ref. 19]

The terms of the contract specified that

> MSC holds firm charters for five years with options to extend to twenty years. At any time after the first five year period, the charters can be terminated upon six months notice. If the charters are terminated before the fourteenth year, MSC liability to the equity investors is so great that it cannot profitably afford to do so. MSC is liable for the termination value of the ships, which for the first twelve years is 122.5 per cent of the capitalized costs. Thereafter the termination value declines to 32.5 per cent of capitalized costs in the twentieth year. Since the nine (Sealift) tankers were constructed specifically to satisfy a long-term MSC requirement, the risk of termination, if existent appears very remote. However, if termination is due to loss or seizure of the ship, a stipulated loss value equal to the termination value of each year is to be paid by the Government. [Ref. 20]

Maritime law stipulates that under these charter terms, MSC has all the rights and obligations of an owner. The title of legal owner is a security title held by the consortium. Under the terms of the charter, MSC must ensure that the ships:

1. are kept free from all liens

2. remain in class with the American Bureau of Shipping

3. are documented under U. S. Coast Guard regulations. [Ref. 21]

At the termination of the contract, MSC must return the ships to their legal owners. Only if MSC defaults on its obligations does the legal owner have the right to repossess the vessels or to terminate the charter.

In the early stages of this program, the Navy utilized a bareboat charter approach in operating the Sealift class tankers. While chartering them from the owner, they were manned and operated by civil service mariners. This arrangement was eventually modified to that which we find today, where MSC actually enters into a contractual agreement with MTL ,Inc., who, in turn, mans and operates the ships under Navy direction.

IV. THE COMPOSITION OF THE TANKER FLEET

A. CHARTER STRUCTURE WITHIN THE FLEET

Although the nature of the MSC tanker fleet structure is one of constant change, it is useful to review its specific makeup at a recent point in time. Figure 4.1 depicts the controlled tanker fleet inventory on 24 August 1984. A review of MSC records illustrates that the composition of the fleet on that day was very typical for recent years. Within the structure of that fleet, ten vessels were under normal time charter, two vessels were operating under bare-boat charter terms, three were Navy owned and civil sevice manned, eight were contractor manned and operated and one was a tug and barge owned by the Navy and manned by civil service mariners.

The three Navy owned and civil service mariner (CIVMAR) manned tankers are designated T-1 tankers and are small, older ships that have been operating under the control of Commander, Military Sealift Command, Far East, headquartered in Yokohama, Japan. The ships have been transporting POL in the mid-Pacific and western Pacific areas but are scheduled to be transferred to the Ready Reserve Force in the near future.

Figure 4.2 reveals the breakdown of the charter arrangements within the controlled fleet, by listing charter classifications and the inventory of ships within each classification. This specific inventory represents the fleet structure in July 1984.

During the past year the size of the controlled fleet diminished from twenty-eight vessels to twenty-four. This change in fleet size took place as a result of a decrease in

SHIP	OWNER	OPERATOR	EMPLOYMENT
SS NEW YORK SUN	SUN OVERSEAS TRANSPORT	SUN TRANSPORT	WPAC
SS TEXAS TRADER	AMER TRADING & TRANS CO	AMER TRADING & TRANS	USG/MED
SS SPIRIT OF LIBERTY	CHAS KURZ & CO	KEYSTONE	AG/UK
MV FALCON LEADER	FALCON TANKERS	SEAHAWK MGT	AG
MV FALCON COUNTESS	FALCON TANKERS	SEAHAWK MGT	AG
MV FALCON CHAMPION	FALCON TANKERS	SEAHAWK MGT	AG
SS NECHES	SABINE TOWING & TRANS	SABINE TOWING & TRANS	WPAC
SS COMANCHE	AMERICAN BULK TANK	AMER BULK TANK	USG/EC
USNS MAUMEE	NAVY	AMER PRESIDENT LINES	MED/GREENLAND
USNS YUKON	NAVY	AMER PRESIDENT LINES	MED/GREENLAND
USNS SEALIFT ANTARCTIC	IRVING TRUST	MTL	MED
USNS SEALIFT ARABIAN SEA	IRVING TRUST	MTL	CARIB/EC/USG
USNS SEALIFT ARCTIC	IRVING TRUST	MTL	USG/WPAC
USNS SEALIFT ATLANTIC	IRVING TRUST	MTL	W COAST
USNS SEALIFT CHINA SEA	IRVING TRUST	MTL	E C/OVH
USNS SEALIFT INDIAN OCEAN	IRVING TRUST	MTL	E C/OVH
USNS SEALIFT MEDITERRANEAN	IRVING TRUST	MTL	EC/USG
USNS SEALIFT PACIFIC	IRVING TRUST	MTL	WC
USNS NODAWAY	NAVY	MSC/CIVMAR	PEARL
USNS ALATNA	NAVY	MSC/CIVMAR	WPAC
USNS CHATTAHOOCHEE	NAVY	MSC/CIVMAR	WPAC
COASTAL MANATEE	GULF TRADING & TRANS CO	COSCOL	USG/EC
COVE NAVIGATOR	COVE TANKERS ASSOC	COVE SHIPPING	CARIB/UK
KINGS CHALLENGER/BARGE HANNAH 4002	NAVY	MSC CIV/MAR	PEARL

Figure 4.1 Strategic Sealift Inventory

Time Charter	Bareboat Charter
SS NEW YORK SUN	USNS MAUMEE
SS TEXAS TRADER	USNS YUKON
SS SPIRIT OF LIBERTY	
MV FALCON LEADER	**Contracted Manning**
MV FALCON COUNTESS	USNS SEALIFT ARCTIC
MV FALCON CHAMPION	USNS SEALIFT ATLANTIC
SS NECHES	USNS SEALIFT CHINA SEA
SS COMANCHE	USNS SEALIFT INDIAN OCEAN
COASTAL MANATEE	USNS SEALIFT MEDITERRANEAN
COVE NAVIGATOR	USNS SEALIFT PACIFIC
	USNS SEALIFT ANTARCTIC
	USNS SEALIFT ARABIAN SEA

NAVY OWNED/CIVMAR
USNS NODAWAY
USNS ALATNA
USNS CHATTAHOOCHEE

Source: Military Sealift Command

Figure 4.2 Controlled Fleet Inventory By Charter Type.

the waterborne transportation requirements specified by DFSC. In this case, DFSC decided to use pipelines to deliver approximately 14 million gallons of POL [Ref. 22] to U. S. East Coast locations by way of the Gulf Coast. DFSC

is expected to continue its efforts to utilize pipelines wherever feasible. Table II illustrates the trend that has taken place in the number of different types of charter arrangements undertaken. It can be seen that the breakdown remained relatively consistent over the four year period.

Besides the increase in pipeline utilization to satisfy DFSC requirements whenever practical, tug and barge combinations are beginning to impact the cost structure of Defense POL transportation. It is simply less expensive to haul the same quantity of petroleum on a tug and barge than it is to haul it on a 10,000 to 50,000 DWT tanker. The reasons are obvious (crew size, fuel consumption, etc.) but will be discussed in more detail in the next chapter. Despite the speed disadvantage suffered, all indications are that tug and barge combinations will begin to take on an increasingly important role in the movement of Defense fuels.

B. THE U. S. FLAG FLEET

It is important, at this stage to have an understanding of the makeup of the U. S. flag fleet since it is this fleet that is the primary resource from which MSC assets are drawn. Although it is not prohibited for MSC to charter foreign flag vessels as long as either a voluntary contractual agreement or a nation-to-nation agreement exists, it is obviously politically inexpedient to do so except as a last alternative. It has been argued that the fact that a U. S. flag fleet exists at all is mainly due to the Jones Act. [6] At the end of June 1984 this fleet was made up of 218 vessels totalling 14.46 million DWT. [Ref. 23] Table III illustrates the distribution of the fleet among size categories.

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[6] The Jones Act is protective Congressional legislation that prohibits any foreign flag vessel from conducting trade between U. S. ports.

TABLE II

Trends in Types of Charters

	1979	1980	1981	1982
Time Charters	3	6	7	6
Consecutive Voyage Charters	2	1	1	0
Bareboat Charters	9	9	9	9
Contracted Manning	9	8	8	8
CivMar	5	5	5	3
Total Tankers	28	29	30	26

Note:

The figures were derived by averaging quarterly statistics from each category and rounding them to the nearest whole number. They are presented in order to provide an example of the typical MSC tanker fleet configuration.

Source: Military Sealift Command

Comparing the information provided in Table III with similar information on the world fleet which is provided in Table IV, it can be seen that the average size for the U. S. flag fleet is 66,000 DWT, while for the world fleet it is

TABLE III

Size of U. S. Flag Tankers

Size Category (DWT)	'000 DWT	%of Total Fleet	No.
10- 39,999	3,646	25	115
40- 69,999	1,864	13	38
70- 99,999	2,730	19	33
100-174,999	1,545	11	12
175-299,999	3,865	27	18
300,000+	809	5	2
Total	14,459	100	218

Source: Drewry Shipping Consultants Ltd

98,500 DWT. In terms of deadweight tons, thirty-eight per cent of the U. S, fleet is less than 70,000 DWT, compared with ninteen per cent for the world fleet. Very Large and Ultra Large Crude Carriers (VLCCs/ULCCs) make up fifty-five per cent of the world fleet while comprising only thirty-two per cent of the U. S. flag fleet. These size statistics are a reflection of the draft limitations faced at most U. S. ports. On the U. S. East and Gulf Coasts the largest tankers that can actually enter port fully loaded are those

of approximately 70,000 DWT, while the West Coast is limited to those of about 150,000 DWT. [Ref. 24]

TABLE IV

World Tanker Fleet

Size Category (DWT)	'000 DWT	% of Total Fleet	No.
10- 39,999	30,395	11	11,178
40- 69,999	21,397	8	385
70- 99,999	32,710	12	383
100-174,999	39,017	14	294
175-299,999	110,173	40	435
300,000+	40,354	15	108
Total	274,046	100	2,783

Source: Drewry Shipping Consultants Ltd.

Table V illustrates the age distribution of the U. S. flag tanker fleet. It reveals that about twenty-two per cent of the fleet is over ninteen years old compared with six per cent for the world fleet. But, at the same time, forty-seven per cent of the U. S. fleet has been built since 1975, comparing favorably to the fifty-three per cent of the world fleet built since that same year.

TABLE V

Age of U. S. Tankers

Built	'000 DWT	% of Total Fleet
1945-50	46	1
1951-55	392	3
1956-60	1,487	10
1961-65	1,209	8
1966-70	1,055	7
1971-75	3,466	24
1976-80	6,032	42
1981-84	772	5
Total	14,459	100

Source: Drewry Shipping Consultants Ltd.

C. AREAS OF OPERATIONS

Tanker assets of the Military Sealift Command controlled fleet and spot charter vessels under single voyage contract to MSC operate over routes between U. S. military installations all over the world, but certainly some more than others. The U. S. Gulf coast, for instance, is heavily travelled by MSC tankers due to the fact that it is a primary offload point for POL destined for continental

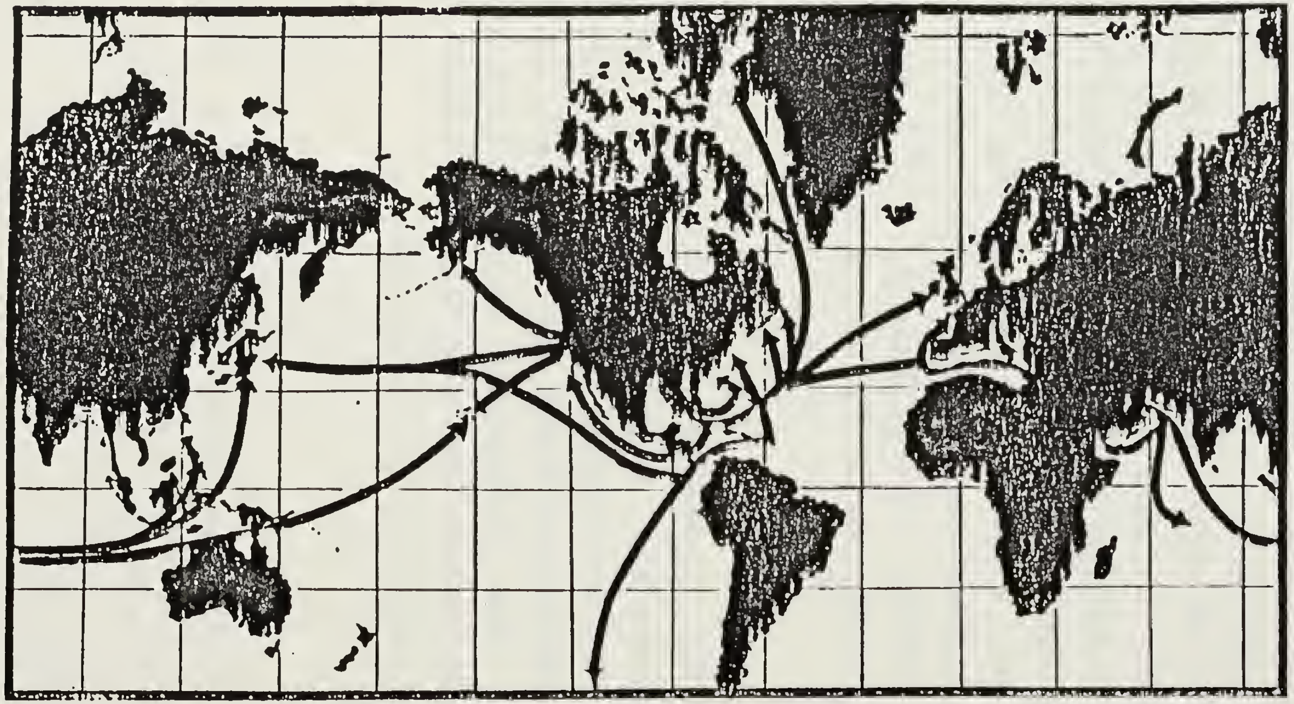
United States Defense activities via pipeline, rail car, highway, or coastal vessel. In the past few years, the Indian Ocean has become an increasingly active operating area for MSC tankers, not only because of the strategic importance of the Diego Garcia installation, but also because of the growing use of the CONSOL. The CONSOL, or consolidated lift of opportunity is an operational concept whereby a MSC tanker is used to either directly refuel ships of the on-station Battle Group or to replenish the Battle Group's fleet tanker. A growing percentage of controlled fleet tankers are capable of performing this mission. Figure 4.3 illustrates the common tanker routes and their proportionate traffic, while Figure 4.4 illustrates the average tanker disposition by operating area.

D. SUMMARY

This chapter has served to define the assets from which MSC is able to draw its tanker resources. It has also provided information concerning the recent charter structure of the current controlled fleet and the areas in which the fleet operates. The following chapter will attempt to analyze the market forces and cost factors that affect the rate structure to which MSC is subjected.

MSC PETROLEUM TRAFFIC - FY 1981

11,967,174 L/T'S



ORIGIN OF LIFT

ARABIAN GULF	9.5%	JAPAN/KOREA	7.2%
U.S. GULF	22.1%	GUAM	6.2%
OTHER U.S.	10.1%	SINGAPORE	1.4%
CARIBBEAN	14.0%	HAWAII	2.8%
MEDITERRANEAN	22.2%	OTHER	.8%
UK/EUROPE	3.7%		

TYPE PRODUCT

JET FUEL	60.4%
FUEL OIL	2.3%
DIESEL	32.3%
AVGAS	.4%
MOGAS	2.0%
OTHER	2.6%

Figure 4.3 Operating Areas of MSC Tankers

FY 1983

AVERAGE DISPOSITION

MSC TANKER FLEET

U.S. GULF/CARIB/WESTLANT	8
EASTLANT/MED	6
WESTPAC	5
EASTPAC	3
ARABIAN GULF	1
INDIAN OCEAN	5

Source: Military Sealift Command

Figure 4.4 AVERAGE DISPOSITION OF MSC TANKER FLEET

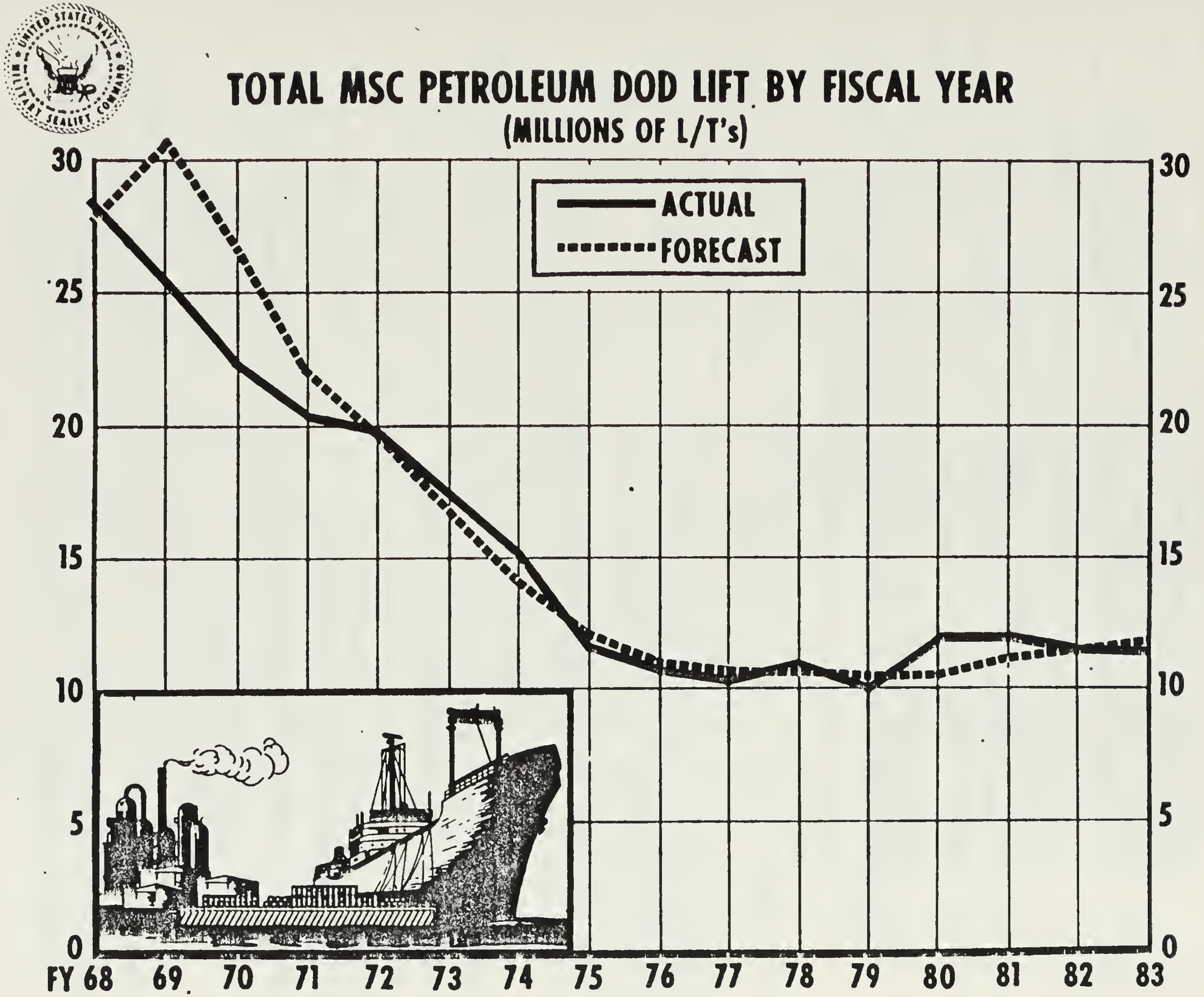
V. TANKER MARKET FORCES AND COST FACTORS

The most fundamental premise of the market forces at work in the tanker industry is that the demand for tanker vessels is a derived demand, based almost exclusively on the general demand for oil itself. This can have a variety of effects on MSC interests. First, in times of low oil demand, the demand for tankers to move oil is generally weak, normally resulting in more favorable charter rates for any organization desiring to have oil moved. On the other hand, a long run result of a low demand condition could very likely be a reduction in the number of tankers available on the market, causing a long run shift in the supply of tankers available and an eventual opposite effect on charter hire rates.

The current state of the industry continues to be low demand, due to the post-embargo phenomenon of wide scale oil conservation and the resultant "glut" on the world market. Tanker demand has, therefore, been low, and supply of available tankers has already experienced dramatic reduction in the Very Large Crude Carrier (VLCC) category, but only modest reduction in the size range that MSC considers useful for its purposes.

The U. S. military has followed world trends in POL transportation in the past decade. As illustrated in Figure 5.1 the quantity of petroleum transported aboard MSC tankers since the late 1960's has decreased dramatically. This decrease is explained by several factors.
This decrease is explained by several factors.

1. The first, and most obvious was the decline of activities related to the U. S. effort in Vietnam.



Source: Military Sealift Command

Figure 5.1 TOTAL MSC PETROLEUM DOD LIFT BY FISCAL YEAR

2. As a result of the Arab oil embargo suffered in late 1973 and early 1974, the military placed a strong emphasis on fuel conservation. This emphasis was manifested in a much more rigorous system of accountability for fuel usage, which was closely monitored by operational and administrative commanders as well as DFSC, which was founded in 1973 to perform just such watchdog and coordinative functions.
3. A new emphasis was placed on alternatives to the large consumption engines of ships, aircraft and ground vehicles and efforts were made to replace the more wasteful units wherever practical. Energy conservation in military facilities was also heavily stressed.

This chapter will summarize and analyze those factors and market forces which contribute to tanker costs and, thus, affect the charter rates MSC is subjected to in the accomplishment of its mission.

A. OVERVIEW OF MARKET FORCES CURRENTLY IN EXISTENCE

The product tanker industry is affected by the following forces:

1. worldwide demand for oil
2. location of refineries
3. advancing technology
4. legislation. [Ref. 26]

Each of these forces will be addressed individually.

1. Worldwide Demand

The worldwide demand for oil, as previously stated, is considered to be relatively weak, resulting in a weak demand for tanker assets. Table VI provides some statistical indication of the level of recent overcapacity.

TABLE VI

Surplus to Demand Ratios for the World Tanker Market

Tanker Size(DWT)	Dec 81	Representative Periods Jan 82	Aug 83	Jul 83	Nov 83
10,000- 39,999	+11%	+11%	+20%	+19%	+15%
40,000-149,999	+27%	+27%	+24%	+34%	+35%
150,000+	+81%	+78%	+110%	+136%	+115%

Note: The surplus to demand ratio is simply the ratio of tankers available for hire to those actually hired for charter.

Source: Lloyd's Shipping Economist

The outlook is for little change in the market until at least the turn of the century, but "outlooks" in oil market analyses are often found to be absolutely wrong. In fact, the petroleum industry is proving to be one of the most difficult to accurately forecast, as evidenced in recent years. Nevertheless, for budgeting reasons, an attempt must be made to ascertain the future of the market. One of the most respected institutions that is involved in shipping industry forecasting is Drewry Shipping Consultants. Based on industry projections of supply and demand, Drewry makes the following assumptions :

1. Oil product consumption is forecast to increase to 1985 and then fall until 1990.(See Table VII)
2. Production is forecast to decline slightly after 1985.
3. A decrease in crude oil movements is forecast by 1990 while a significant increase in (clean) products is

forecast by that same year. This rise in products movements is due to a huge increase in products imports expected from the Middle East by 1990. These imports are expected to rise from about one million tons in 1985 to about 22 million tons in 1990 as a result of a large increase in the number of refineries in that part of the world. Of course, this is an economic forecast and does not address the potentiality of complete disruption of the refining industry in that part of the world as a result of international conflict. [Ref. 27]

TABLE VII

U. S. Production and Consumption 1980-1990

Year	Production	Consumption	Net Imports(a)
1980	484	794	310
1982	485	706	221
1983(b)	485	700	215
1985	465	712	247
1990	446	688	242

Notes: (a) During the historical period net imports include stock change and statistical discrepancy.

(b) Preliminary

Data is in millions of tons per year.

Source: BP Statistical Review 1984

Drewry's forecast elaborates on the last aspect of increased products importation from the Middle East by stating that the refinery capacity of the United States East Coast is expected to fall from the 727 million tons produced in 1981 to 640 million tons by 1990. Already, refinery closures have taken place and plans for more to do so have been finalized. [Ref. 28] Although it is assumed that there will be an increase in capacity utilization in the U. S. refineries of from seventy-two per cent in the early 1980s to about seventy-six percent by 1990, this is not expected to significantly offset the effect of the reduction in refinery facilities. The demand for refined products is expected to remain somewhat stable throughout the period in question, but, given the expected decrease in U. S. industry capacity, the U. S. will not be able to supply the demand, and greater imports will result. These imports are not expected to originate from the traditional areas, but, instead, from the Middle East and North Africa. Because the distances from these locations to the United States East Coast are much greater than from the Caribbean, which is the current primary supplier of refined products, there will be a disproportionate increase in tanker demand generated by the increase in products demand (Figure 5.2).

2. Location of Refineries

"Geographically,the initial consideration lies in the location of crude oil resources in relation to the refined product market. Theoretically, as long as oceans separate crude oil suppliers from petroleum markets, tankers will be in demand" [Ref. 29]. With the exception of the U. S. refinery industry, which was discussed in the previous subsection and of which we are more concerned for the purposes of this study, this theory has lost some impact in recent years as developing and some established countries

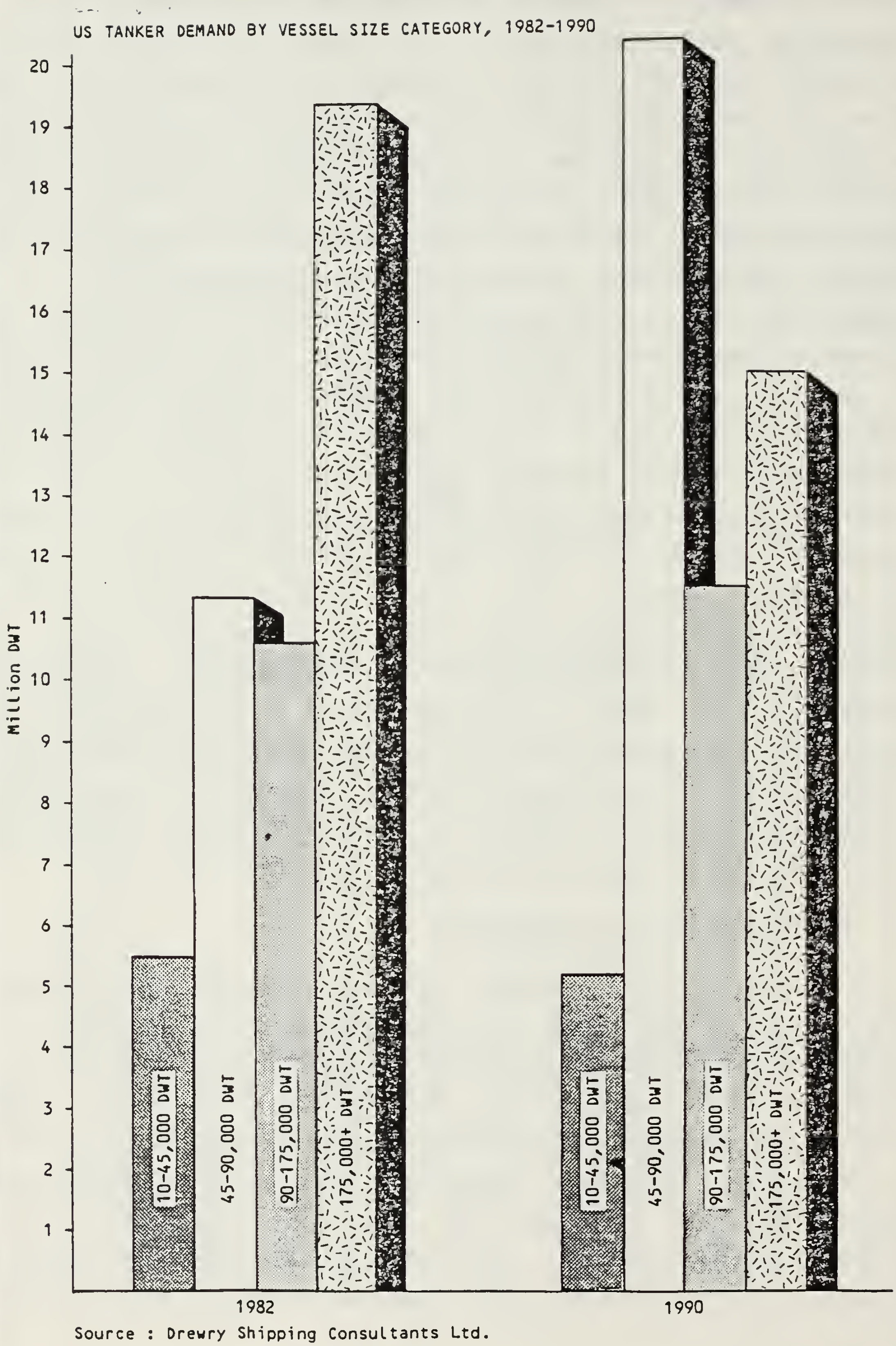


Figure 5.2 U.S. Tanker Demand by Vessel Size Category

have increased their number of refineries. "These localized refineries allow petroleum markets to take advantage of economies of scale by transporting larger quantities of crude to the market area, thereby reducing transportation costs as well enabling the use of other transportation modes (i.e., pipelines, etc.)" [Ref. 30]. The growth of pipeline construction has been a logical result of this phenomenon.

From MSC's perspective, another extremely important factor of refinery location pertains to depth of water at refinery port facilities.

> Economically, a large ship in clean trade would lose money. Its service would be limited to ports large enough to accomodate it. It would spend excessive time in port, loading and discharging, because the throughput of most refineries and discharge areas is still geared to the small clean product tanker. [Ref. 31]

3. Advancing Technology

The technology aspect of tanker market forces is one which, due to its deliberate, evolutionary nature, can be anticipated with more certainty as to the effect it will have on the market. Currently, there are several innovations that are either in the conceptual or design stage or are in their operational infancy. Among these are:

1. Pipelines. Although pipeline technology is nothing new, the extent to which it is now being utilized and its anticipated growth as a transportation medium for POL is unprecedented. The most immediate effect of pipeline expansion will surely be an increase in the overcapacity of tankers in the size range useful to MSC.
2. Tug and barge combinations. This technology, also, has been available for many years, but has only recently gained dramatically in popularity within the industry as a means to transport large quantities of POL over large distances. The cost savings in

personnel and fuel could no longer be overlooked. It is anticipated that MSC will continue to increase its utilization of this technique in the foreseeable future. Figure 5.3 compares the capabilities and costs of an integrated tug/barge unit and a tanker.

3. Ultra shallow draft vessels (USDVs). Currently on the drawing boards is a vessel that will have the capacity of deep draft tankers but with a much shallower draft. Tank space compensation will take place in a much wider beam, and the decreased hydrodynamics will be compensated for with increased engine horsepower. Obviously, with the increased horsepower will come increased fuel costs. Data on the proposed USDV are provided in Table VIII.

4. Legislation

Several impending and recently enacted legislative acts, both national and international, are expected to exert profound influence on tanker market forces in the years to come. Among the most significant of these legislative actions is the 1978 Protocol sponsored by the Inter-Governmental Maritime Consultative Organization at the 1974 Safety of Life at Sea Convention. Effective in May of 1981, this legislation required that strict new safety and pollution control measures be adopted by a large portion of the international shipping industry. In 1978 the United States adopted these measures into the Port and Tanker Safety Act. The most significant portion of the act pertained to the requirement for segregated ballast tank systems (SBT) and inert gas systems (IGS). IGS is an extensive modification to existing tank systems requiring that non-flammable, inert gases be introduced into the tanker piping systems rather than volatile oxygen combinations. Figure 5.4 provides a schematic of a typical IGS system.

COMPARISON BETWEEN A TANKER AND INTEGRATED TUG/BARGE UNITS

INTEGRATED TUG-BARGE

	MARGATE TANKER	INGRAM'S TUG/BARGE	MODIFIED TUG/BARGE
DEADWEIGHT	37,100	36,500	37,500
CAPITAL COST 1/1/1974	$18,166,700	$12,944,800	$12,244,800
COST PER DWT	$ 490/TON	$ 355/TON	$ 327/TON
SPEED - KNOTS	15	13	
OUT-OF-SERVICE TIME/YEAR - DAYS	15	17.7	
ANNUAL OPERATING COSTS 1974 (EX CAPITAL RECOVERY)	$2,179,415	$1,929,025	$1,929,025
FREIGHT RATE GALVESTON/PHILA. WITH 10% RETURN	$4.42/TON	$3.93/TON	$3.74/TON
REDUCTION IN RATES VS TANKER	0	11.1 %	15.4 %

Source: Maritime Administration Report, June 1973

Figure 5.3 Comparison Between a Tanker and Integrated Tug/Barge Units

TABLE VIII

Comparison of Conventional Tankers with Proposed USDV

	Conventional	USDV	Conventional	Conventional
Draft (ft)	47.2	32.8	32.8	32.8
DWT	104,000	104,000	23,500	34,200
Length (ft)	853	755	573	546
Beam (ft)	128	210	78	105
HP	20,500	24,000	10,600	11,200
Spd (kts)	15	14.4	16	15.5

Source: Tanker Register and Motor Ship, September,1981

The costs involved in IGS installation are significant, approaching one million dollars for a product tanker of forty to fifty thousand DWT. Tanker owners would have no alternative but to either pass these costs on to the customer or consider retiring the vessel from service to avoid the installation expense.

While the the IGS portion of the act is primarily safety oriented, the portion mandating the SBT systems is environmentally oriented. The SBT concept involves reserving certain tanks for ballast in order to prevent the pumping of contaminated gaseous mixtures overboard to make room for ballast. The impact of this portion of the act is obvious. The segregated ballast tanks represent lost

product capacity, a factor which is certain to affect the cost structure.

In any case, the cost of conforming to this legislation is currently one of MSC's greatest concerns. It is still not clear what the impact of the the new requirements will be on the size of that portion of the tanker fleet that MSC considers to be useful for its purposes. At mid-1983. twenty-eight per cent of the total products tanker fleet was at least fifteen years old and approaching the end of its useful life. Of this tonnage, ninety per cent was smaller than 40,000 DWT, and very little of it met the regulations requiring IGS.

B. TANKER COST FACTORS

1. Operating Costs

One of the main influences on total operating cost trends are the movements in manning costs, as these costs account for forty to fifty per cent of the total. "While the general level of inflation will continue to be the principal determinant of manning costs, the activities of national seamen's unions and the International Transport Federation (ITF) will also have a significant impact on average manning costs" [Ref. 32]. Currently, manning costs on convenience-flag vessels are increasing at a faster rate than those on European or U. S. rates, although they still are not comparable. [Ref. 33]

One area which promises to improve the manning cost situation is the trend towards smaller crews. This trend has been most evident among the high cost flags such as those of northern Europe or the United States. Norway, for instance, and despite intense labor pressure, has approved shipownersreducing their crews by up to eight men on the larger tankers. Japan, also, has been experimenting with

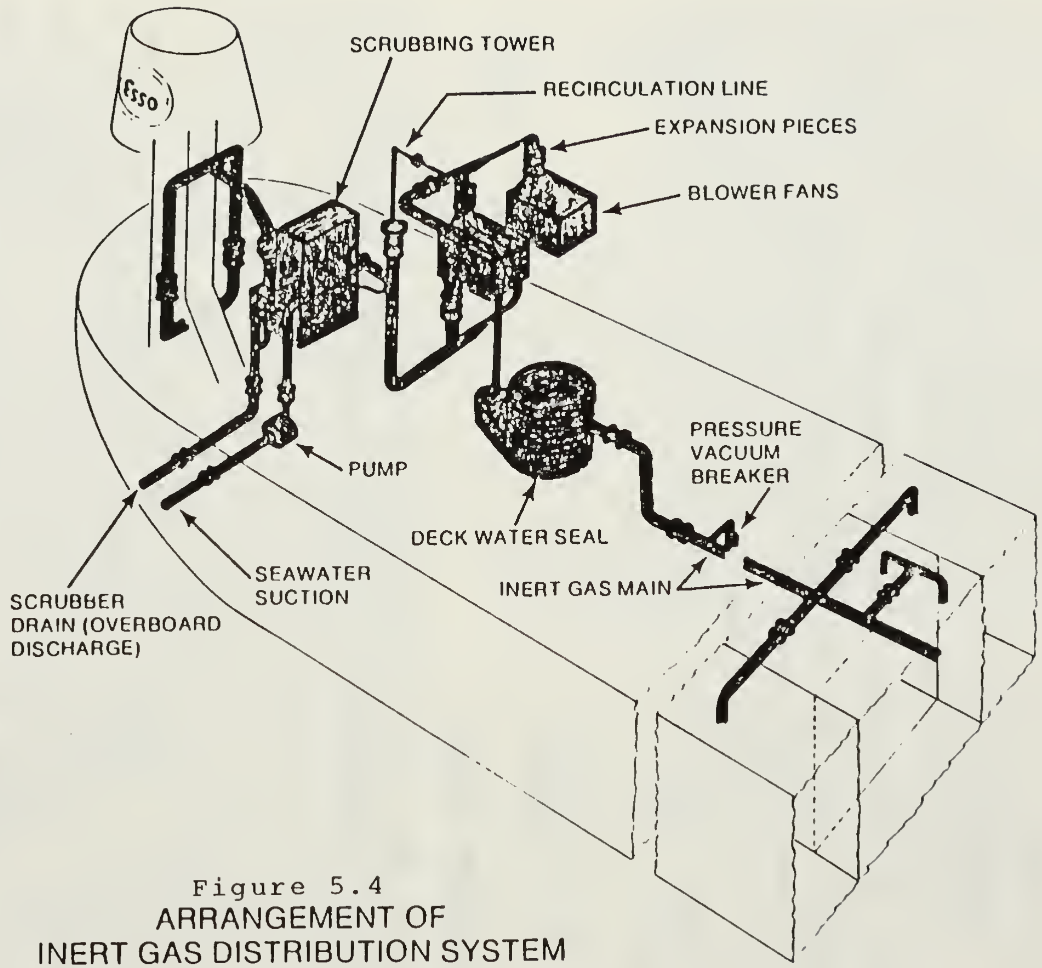


Figure 5.4
ARRANGEMENT OF
INERT GAS DISTRIBUTION SYSTEM

smaller crews, operating a series of demonstration ships with eighteen man crews and eventually planning to man some of the same size vessels with sixteen men. Under this concept, the crew is considered to be dual purpose with deck and engineroom personnel totally interchangeable. Obviously, with current ship designs and the strength of maritime labor, this innovation will not be adopted quickly, if at all.

Repair and maintenance costs have increased at a rapid rate in recent years. One reason for this is widespread conversion to IGS and SBT systems, but a contributing factor is more rigid material standards being enforced by maritime authorities.

2. Voyage Costs

Primarily as a result of the rapidly rising fuel costs of the last decade, voyage costs have become, in many cases, the most significant cost factor for tanker operators. In the short term, many shipowners were attempting to combat this increase with slow-steaming policies, but this often had the effect of increasing operating and capital elements of total transportation costs per cargo ton. [Ref. 34] Instead, tanker operators have now turned to energy efficient designs for new construction and are incorporating some aspects of these improved design factors in ships already in operation. These innovations include:

1. slow-speed, fuel efficient main engines
2. improved hull forms
3. ducted and controllable pitch propellers
4. anti-fouling hull coatings
5. waste heat recycling.

These design improvements have resulted in reductions of up to one-third the original fuel consumption rate in those ships in which they are installed, with little or no loss of speed.

Practically all tankers currently on order worldwide feature some or all of these design innovations. As more and more of these vessels enter the market and an increasing number of those already operating adopt some of the features, the fuel efficient tanker will become the benchmark by which tanker rates are set.

3. Capital Costs

The changes in capital costs in recent years has taken place not so much in the quantity or the nature of the costs but in their allocation. In other words, the amount of capital required to enter the tanker market has not changed significantly in recent years, but the recipients of those funds have changed. Japan, for many years the shipbuilding giant, is receiving increasing competition from several of the emerging nations, such as South Korea and Taiwan. It is expected that this new competition will prevent a significant increase in new shipbuilding prices in the next few years.

4. Conclusion

Although at first glance any discussion of the economics of petroleum transportation would appear to lack any cohesion, the one central theme is that all of the individual factors contribute to the rate level that a customer will be subjected to if he hires a tanker to move his POL. Most of these factors are not controllable from the shipper's perspective, but a thorough understanding of all the factors is essential in order to make short run and long run decisions concerning alternative modes of transportation, purchase of his own vessels, or delay of the move altogether until a more economically opportune time, if operationally feasible.

VI. SUMMARY AND CONCLUSIONS

This study was originally intended to pursue a minimum cost solution to an optimum mix of tanker charter types.But it became apparent during the interviews and data collection phase that the erratic nature of the tanker market and the rapidly changing economic environment would preclude such a quantitative approach. The essential determination of the constraints necessary to accomplish such a solution were beyond the scope of this study. Instead, an attempt has been made to present the material necessary to understand the tanker market and how its future will affect the transportation of Defense POL.

It is apparent that there is a very immediate area of concern, that of the future impact of the legislation concerning Segregated Ballast Tanks and Inert Gas Systems. It is apparent that the size of that portion of the product tanker market which MSC considers useful for its purposes is going to decrease as vessels are scrapped to avoid the capital expenditures necessary to bring them within the legislated guidelines. To avoid higher charter rates that will result from this tanker supply situation, alternative transportation modes must be considered. Of those discussed, the most advantageous appears to be the tug and barge combination. The data presented in this study is evidence of the suitability of this mode of transportation for most contingencies.

Operational readiness and contingency preparation (surge capacity) were considered to be beyond the scope of this study, which was to focus, primarily, on the economic aspects of tanker operations.

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